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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/734,318

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Armen Kroyan

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SILCON VALLEY PATENT GROUP LLP  
2350 MISSION COLLEGE BOULEVARD  
SUITE 360  
SANTA CLARA, CA 95054

EXAMINER

ROSASCO, STEPHEN D

ART UNIT

PAPER NUMBER

1756

DATE MAILED: 04/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/734,318

Applicant(s)

KROYAN, ARMEN

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on 27 January 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 8-22 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-7 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 1/4/05.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

**Detailed Action**

Applicant's election without traverse of Group I (claims 1-7) in the reply filed on 1/27/06 is acknowledged.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Claim 1-7 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitations of:

- 1) "identifying a plurality of critical openings in the first mask data" - it is unclear from a reading of the claims to what the "openings" are referring. Is it in the data itself or in the pattern that the data represents?
- 2) "determining a threshold intensity for the plurality of critical openings during the photolithographic process" – it is unclear if the term "threshold intensity" refers to a light absorption quality of the resist or some other exposure parameter.
- 3) the meaning of the last part of the claim that recites "modifying..." would depend on the meaning of "threshold intensity" above, so that the meaning here would also be unclear.

Claims 2 and 4 would be clearer if the limitation of "increasing the area" of the cut would include a reference that this refers to an opening, e.g., increasing the open area of the cut, or increasing the light transmissive area of the cut.

Claim 3 (similarly 5-7) recites the phrase “maximum intensity of the opening” – this is unclear, in that it is not the opening itself that has “intensity” but the light passing through the opening.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 1-7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Tsudaka (5,825,647).

Tsudaka teaches (see claims 1-11) a method for correcting a mask pattern in which the mask pattern of a photomask to be used in a photolithographic step is deformed so that a transfer image near a desired design pattern is obtained, comprising the steps of: arranging a plurality of evaluation points along an outer periphery of the desired design pattern;

simulating the transfer image to be obtained where exposure is carried out under predetermined transfer conditions by using a photomask of the design pattern based on the evaluation points;

comparing a difference between the simulated transfer image and the design pattern for every evaluation point; and

deforming the design pattern according to the difference compared for every evaluation point so that the difference becomes smaller.

And wherein in the simulation step, two-dimensional light intensities on a substrate are calculated based on the design pattern and exposure conditions;

effects of the light intensities at a plurality of peripheral positions on exposure energy at an arbitrary position are calculated and cumulatively added based on the light intensities at the peripheral positions of that arbitrary position on the two-dimensional plane of the substrate and the distance between that particular position and the peripheral positions, whereby a latent image formation intensity at that arbitrary position is calculated on the two-dimensional plane of the substrate; and further comprising the steps of: finding a distribution of the latent image formation intensities on the two-dimensional plane of the substrate;

determining a threshold value of the latent image formation intensity corresponding to the amount of exposure and development conditions;

finding contour lines at the threshold value for the distribution of the latent image formation intensities; and calculating the pattern defined by the contour lines as a transfer image.

And wherein target points are set corresponding to evaluation points positioned at convex corners or concave corners of the design pattern, the target points are determined inside the corner at the convex corners, and the target points are determined outside the corner at the concave corners.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over or Bula et al. (6,383,719) or Sugita et al. (6,534,242) in view of Tsudaka (5,825,647).

The claimed invention is directed to a method for generating a complementary mask data for use in a photolithographic process, the method comprising: receiving a first mask data corresponding to the complementary mask; identifying a plurality of critical openings in the first mask data; determining a threshold intensity for the plurality of critical openings during the photolithographic process; modifying the plurality of critical openings such that each of the plurality of critical openings will provide at least the threshold intensity during the photolithographic process.

And wherein modifying comprises: increasing the area of at least one cut, and the increase in area is proportional to the difference between: a maximum intensity of the opening prior to increasing and said threshold intensity.

The applicant discusses the limitations of the prior art in that when substantially all features in a layout for a layer of material in an integrated circuit are defined using a phase shifting mask, the related complementary mask that is normally used to define the remaining features and edges can be improved if intensities in an aerial image from openings on the complementary mask that are below threshold are increased to ensure that each opening meets or

exceeds threshold. Such increase of intensities improves effectiveness of critical openings that are otherwise too small to print.

Absent intensity increase, such openings could limit the application of optical lithography using phase shifting masks to ever shrinking technologies. The intensities are increased in some embodiments by enlarging some openings in the complementary mask in directions not constrained by features to be formed in an integrated circuit (by use of the phase shifting mask).

Bula et al. teach fine feature lithography is enhanced by selectively providing exposures to correct for effects such as foreshortening, corner rounding, nested to isolated print bias, feature size dependent bias, and other image biases in semiconductor processing. These results are achieved by increasing the local exposure dose in critical areas of specific images, such as line ends and corners.

The use of a second block opaque mask (containing opaque regions overlapping the ends of the opaque regions of the first mask) is exposed with the low dose (10-20% of the conventional exposure) needed to fully activate those portions of the resist other than those blocked by both masks. The same result occurs as with the clear opening approach described herein above. One can tailor the resulting exposure to achieve a more optimal distribution of light intensity with two masks than with one mask, whether one uses two masks with complementary opaque regions, or two masks with complementary clear regions. These two cases apply for both positive tone resist and for negative tone resist.

Sugita et al. teach (see claims 91-92) a pattern forming method including exposure of a resist and development of the same, said method comprising: a first exposure amount distribution

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with an exposure amount not greater than an exposure threshold value of the resist, on the basis of periodic pattern exposure; and a second step for applying, to the resist, a second exposure amount distribution including a first portion with an exposure amount not being equal to zero but being not greater than the exposure threshold value and a second portion with an exposure amount not less than the exposure threshold value, by use of a mask having a pattern analogous to the pattern, wherein a portion of the pattern is formed on the basis of a portion of the first exposure amount distribution to be superposed with the first portion of the second exposure amount distribution, and wherein another portion of the pattern is formed on the basis of the second portion of the second exposure amount distribution to be superposed with another portion of the first exposure amount distribution.

The teachings of Bula et al. or Sugita et al. differ from those of the applicant in that the applicant teaches that the complementary mask that is normally used to define the remaining features and edges can be improved if intensities in an aerial image from openings on the complementary mask that are below threshold are increased to ensure that each opening meets or exceeds threshold.

Tsudaka is included here as discussed above.

It would have been obvious to one having ordinary skill in the art to take the teachings of Bula et al. or Sugita et al. and combine them with the teachings Tsudaka of in order to make the claimed invention because it would have been obvious to one to adjust the size and configuration of the openings in the exposure with the second mask in order to make the claimed invention because Tsudaka amply teaches the advantages of exposure at the threshold intensity.



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*Conclusion*

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized, sweeping flourish at the end.

S. Rosasco  
Primary Examiner  
Art Unit 1756

S. Rosasco  
4/20/06